North Dakota Department of Health

Division of Water Quality
Surface Water Quality Management Program

North Dakota's Water Quality Monitoring Strategy for Surface Waters

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I. INTRODUCTION

A. Background

The federal Clean Water Act provides the regulatory context and mandate for state water quality monitoring and assessment programs. The North Dakota Department of Health has been designated as the state water pollution control agency for purposes of the federal Clean Water Act and, as such, is authorized to take all actions necessary or appropriate to secure for the state all benefits of the Clean Water Act and similar federal acts (NDCC 61-28-04). State law establishes policy to protect, maintain and improve the quality of waters of state, while the overall goal of the federal Clean Water Act is to "restore and maintain the chemical, physical and biological integrity of the Nation's waters."

Various sections in the Clean Water Act require states to conduct specific activities to monitoring, assessment and protect their waters. These activities include:

- Developing and adopting water quality standards designed to protect designated beneficial uses (Section 303).
- establishing monitoring programs to collect and analyze water quality data (Section 106).
- Reporting on the status of waters and the degree to which designated beneficial uses are supported (Section 305[b]).
- Identifying and prioritizing waters that are not meeting water quality standards (Section 303[d]).
- Assessing the status and trends of water quality in lakes and identifying and classifying lakes according to trophic condition (Section 314).
- Identifying waters impaired due to nonpoint sources of pollution as well as identifying those sources and causes of nonpoint source pollution (Section 319).

B. North Dakota's Surface Water Resources

The North Dakota Department of Health currently recognizes 224 lakes and reservoirs for water quality assessment purposes. Of this total, 134 are manmade reservoirs, and 90 are natural lakes. All lakes and reservoirs included in this assessment are considered significantly publicly owned. Based on the state's Assessment Database, the 134 reservoirs have an areal surface of 542,868 acres. Reservoirs comprise about 76 percent of North Dakota's total lake/reservoir surface acres. Of these, 480,731 acres or 67 percent of the state's entire lake and reservoir acres are contained within the two mainstem Missouri River reservoirs (Lake Sakakawea and Lake Oahe). The remaining 132 reservoirs share 62,137 acres, with an average surface area of 471 acres. The 90 natural lakes in North Dakota cover 172,051 acres, with approximately 125,000 acres or 73 percent attributed to Devils Lake. The remaining 89 lakes average 523 acres, with half being smaller than 200 acres.

There are 54,427 miles of rivers and streams in the state. Estimates of river stream miles

in the state are based on the National Hydrography Dataset (NHD) and include ephemeral, intermittent and perennial rivers and streams.

One of the most significant water resource types in the state are wetlands. There are an estimated 2.5 million acres of wetlands in the state. The majority of these wetlands are temporary, seasonal, semi-permanent and permanent depressional wetlands located in what is commonly called the Prairie Pothole Region.

C. Purpose and Scope

This document describes the North Dakota Department of Health's strategy to monitor and assess its surface water resources, including rivers and streams, lakes and reservoirs and wetlands. It does not address ground water monitoring and assessment or regulatory monitoring for National Discharge Pollution Elimination System (NDPES) permit compliance. For more information on ground water monitoring and assessment and NDPES compliance monitoring, the reader is referred to the Division Water Quality's Ground Water Protection and Permit Programs, respectively.

This strategy also fulfills requirements of Clean Water Act Section 106(e)(1) that requires the U.S. Environmental Protection Agency (EPA), prior to awarding a Section 106 grant to a state, to determine that the state is monitoring the quality of its waters, compiling and analyzing data on the quality of its waters and including those data in its Section 305(b) report. An EPA guidance document entitled *Elements of a State Water Monitoring and Assessment Program* (EPA, March 2003) outlines 10 key elements of a state monitoring program necessary to meet the prerequisites of CWA. The 10 key elements are:

- Monitoring Program Strategy.
- Monitoring Objectives.
- Monitoring Design.
- Core and Supplemental Water Quality Indicators.
- Quality Assurance.
- Data Management.
- Data Analysis/Assessment.
- Reporting.
- Programmatic Evaluation.
- General Support and Infrastructure Planning.

The purpose of this multi-year strategy is to describe the goals, objectives, scope and plan for surface water quality monitoring conducted by the North Dakota Department of Health. While the department recognizes and benefits from numerous state, federal and local partners in the state that conduct monitoring and assessment activities, this document does not provide direction for monitoring efforts outside the responsibility of the department.

II. TYPES OF MONITORING

Environmental monitoring data, including water quality monitoring data, can be categorized by the purpose for the monitoring and how the information is assessed and used. In general, the categories are: 1) condition monitoring, 2) problem investigation monitoring, 3) effectiveness monitoring and 4) special studies monitoring.

While there are similarities among the four monitoring types, these definitions are provided to help distinguish between the various purposes of monitoring programs and projects necessary to meet the goals and objectives of this strategy.

Condition monitoring is used to identify overall water quality status and trends by assessing the condition of individual waterbodies, populations of waterbodies or watersheds in terms of their ability to meet water quality standards or other established criteria (i.e., water quality index or biological indicators). The primary focus of condition monitoring is on understanding the status of the water resource, identifying changes in water quality over time and in identifying and defining problems at the watershed or ecosystem level. Examples of condition monitoring include ambient water quality or rotating basin monitoring for Section 305(b) reporting, lake water quality assessments and Section 303(d) Total Maximum Daily Load (TMDL) listing activities.

Problem investigation monitoring involves studying specific water quality problems or watershed restoration issues that results in the development of a management or remediation plan to protect or improve the resource. Problem investigation monitoring is used to determine the specific causes and sources of water quality impairments to rivers, streams, lakes, reservoirs or wetlands and to quantify pollutant loads. It is also used to determine the actions that are needed to return a waterbody to a condition that meets standards or other water quality goals. Examples of problem investigation monitoring include TMDL development projects, Section 319 Nonpoint Source (NPS) Pollution assessment projects and the investigation of specific water pollution issues (e.g., fish kills or pollution spills).

Effectiveness monitoring is used to assess the effectiveness and success of specific regulatory or voluntary management actions that have been implemented to improve or protect water quality. Effectiveness monitoring is not only used to evaluate the immediate success of management actions, but is used in an adaptive management framework to improve and refine management actions to meet the projects goals. Examples include monitoring for TMDL implementation projects or Section 319 NPS watershed restoration projects.

Special studies monitoring addresses monitoring activities that do not fit neatly into the other three categories. Typically, special studies monitoring would not directly result in an assessment of a specific lake, stream or wetland or in the implementation of management actions for specific waterbodies or watersheds. These studies would include those stream, lake and wetland studies that are more research-focused. Examples include monitoring for emerging issues such as pharmaceuticals, monitoring related to toxic

pollutants such as mercury or pesticides, monitoring focused on specific geographic areas and studies focused on a specific problem, pollutant source, sampling method or to answer a specific question. These types of studies typically have a very specific purpose and are generally of relatively short duration.

III. MONITORING AND ASSESSMENT GOAL, OBJECTIVES AND GUIDING PRINCIPLES

A. Monitoring and Assessment Goal

As stated earlier, the overall water quality goal of the state is "to protect, maintain and improve the quality of waters of the state," while the overall goal of the federal Clean Water Act is to "restore and maintain the chemical, physical and biological integrity of the Nation's waters." In support of these goals, this strategy and the department have established a water quality monitoring goal ***"to develop and implement monitoring and assessment programs that will provide representative data of sufficient spatial coverage and of known precision and accuracy that will permit the assessment, restoration and protection of the quality of all the state's waters."*** In support of this goal and the water quality goals of the state and of the Clean Water Act, the department has established 10 monitoring and assessment objectives. In order to fully meet these objectives, it will require additional time and resources to acquire and to develop the necessary database(s), indicators and staff expertise.

B. Monitoring and Assessment Objectives

The following objectives have been established to meet the goals of this strategy. They are:

- Provide data to establish, review and revise water quality standards.
- Assess water quality status and trends.
- Determine beneficial use support status.
- Identify impaired waters.
- Identify causes and sources of water quality impairments.
- Provide support for the implementation of new water management programs and for the modification of existing programs.
- Identify and characterize existing and emerging problems.
- Evaluate program effectiveness.
- Respond to complaints and emergencies.
- Identify and characterize reference conditions.

C. Guiding Principles

This strategy also incorporates six guiding principles considered by the department to be essential for effective monitoring and necessary to meeting the goals and objectives.

Principle 1: Integrate and coordinate the use of scarce monitoring resources with those of other agencies and organizations.

The scarcity of funds and other resources necessary to adequately monitor and assess the state waters demands the department work closely with other entities, both public and private, to ensure the broadest possible coverage of the state's surface water resources. The department will seek opportunities to collaborate with other organizations to plan and implement monitoring programs and projects.

Principle 2: Maximize the use of local units of government and citizen volunteers to monitor surface water quality.

Local units of government such as soil conservation districts, water resource boards and cities have be important partners in conducting monitoring for nonpoint source assessments and for developing TMDLs. Citizen volunteers in the form of lake associations have conducted lake water quality monitoring. By using local governments and citizens in the monitoring, more waters can be assessed. When local governments and citizens volunteers are involved in collecting the data they are more likely to take the necessary steps to address water quality problems. Screening level monitoring by competent citizen volunteers will make more time for department staff to address complex problems and issues.

Principle 3: Schedule field studies and other data acquisition activities to be consistent with the department's rotating basin monitoring schedule.

North Dakota is a large state, and as a result, the expenditure of resources for travel and other logistics can be considerable. To the extent practical, monitoring programs and projects should be coordinated to occur within a basin at the same time. This would also facilitate the integration of data and reporting across water resource types.

Principle 4: Use a tiered monitoring approach consisting of rapid assessment of screening level assessments at numerous sites and intensive study designs at a smaller subset of pre-screened sites.

Whenever possible, the department will use rapid assessments or screening level studies to initially evaluate the water quality condition of a waterbody. If the initial screening data suggests a potential problem exists, then more intensive monitoring will be performed by department staff to verify the problem and to determine its specific cause and source. This tiered approach will result in the assessment of more waters each year and will allow the department to focus limited resources on those waters with the most pressing needs.

Principle 5: Generate monitoring data that are scientifically defensible and relevant to the decision-making process.

All of the monitoring activities in this strategy are linked to specific goals and objectives and are established to be consistent with sound scientific and statistical concepts. Emphasis is given to quality assurance and quality control processes and procedures that will result in data that are of known precision and accuracy sufficient to support sound management decisions.

Principle 6: Manage and report water quality data in a way that is meaningful and understandable to the intended audience.

For monitoring data and information to be truly useful, it must be managed properly and reported to intended audiences in not only a meaningful way but in a timely manner. This strategy provides a commitment to data automation and the establishment of data management policies and procedures to ensure that water quality data are easily accessible and understandable to department staff, other agencies and organizations and the public. Water quality monitoring and assessment programs, projects and studies should recognize that different levels of detail are needed for both data analysis and reporting depending on the audience.

IV. MONITORING PROGRAMS, PROJECTS AND STUDIES

In order to meet the goals and objectives outlined above, the department has taken an approach which integrates several monitoring designs, both spatially and temporally. Monitoring programs include fixed station sites, stratified random sites, rotating basin designs, state-wide networks, chemical parameters and biological attributes. In some cases, department staff conduct the monitoring, while in other instances monitoring activities are contracted to other agencies such as soil conservation districts, the U.S. Geological Survey (USGS) or private consultants.

In the following sections, current monitoring activities are documented in the form of narrative descriptions. This includes the project or program purpose (objectives), monitoring design (selection of monitoring sites), selected parameters and the frequency of sample collection. Where appropriate, there is also a description of enhanced program or project elements. The enhanced program or project identifies what would be required to fulfill all of the goals and objectives of this strategy assuming unlimited financial and manpower resources are available.

A. Ambient Water Quality Monitoring Network for Rivers and Streams

1. Current and Historic Program

The department's "Ambient Water Quality Monitoring Network for Rivers and Streams" was established in the 1960s. The primary purpose of this network is to provide data for trend analysis, general water quality characterization and

pollutant loading calculations. Although the network has undergone several modifications since that time, the network currently consists of 33 fixed-station ambient monitoring sites located on 19 rivers (Table IV-1 and Figure IV-1). Sites are both wadeable and non-wadeable. Where practical, these sites are co-located with USGS flow-gauging stations. Samples are collected and analyzed for water chemistry and bacteria at each of these sites every six weeks during the open-water period (generally from early April through November) and once during the winter under ice cover (generally in late January or early February). Parameters include: major ions, trace elements, total suspended solids, total phosphorus, total nitrogen, ammonia, nitrate-nitrite, Total Kjeldahl Nitrogen, fecal strep. bacteria, fecal coliform bacteria and E. coli (Table IV-2). Field measurements are taken for dissolved oxygen, temperature, conductivity and pH.

Through a cooperative agreement with the USGS, a new component was added to the network in September 2003. Equipment installed at the USGS gauging station at Fargo (USGS site 05054000) monitors field parameters continuously. Data are collected through the deployment of a continuous recording YSI Model 600 multi-probe sonde and datalogger. Output from the sonde is transmitted via telemetry and the data posted "real-time" on the USGS North Dakota district web site. The USGS is also collecting water quality samples 10 times per year from this site, and these are being analyzed for major cations and anions, total suspended sediment, total phosphorus, total nitrogen, ammonia, nitrate-nitrite and fecal coliform bacteria. As this data set increases, regression relationships will be developed for selected water quality variables (e.g., total suspended sediment, TDS, total phosphorus and total nitrogen) using the continuously recorded field parameters. The goal of this system will be to use these regression relationships to provide "real-time" concentration estimates of total suspended sediment, total phosphorus, total nitrogen and TDS and to post the data on the web.

2. Enhanced Program

An enhanced program for ambient water quality monitoring would include better temporal and spacial coverage. The current frequency of sampling every six weeks during open water and once during winter results in six to seven samples collected from each site each year. There are also several rivers and streams that are not monitored. In a trends analysis of existing water quality data across the state, the USGS (Vecchia by personal communication, 2004) recommends a minimum of nine samples per year (monthly sampling from March through August and bimonthly from October through February) as an efficient design for monitoring long-term trends. It has also been shown that this design can be an efficient monitoring frequency for estimating average annual loads over a five- to ten- year period.

Based on the results of the continuous monitoring station at Fargo, an enhanced program would also include additional continuous monitoring stations that would provide real-time field monitoring data and concentration estimates for selected water quality variables over the web.

Table VI-1. Ambient Water Quality Monitoring Network Sites

Station ID	River	Location
380161	Souris River	above Minot
380021	Des Lacs River	at Foxholm
380095	Souris River	at Verendrye
385055	Bois de Sioux	near Doran, MN
380083	Red River	at Brushville, MN
380031	Wild Rice River	near Abercrombie
385040	Red River	near Harwood
380010	Sheyenne River	at Warwick
380009	Sheyenne River	3 mi E of Cooperstown
380153	Sheyenne River	below Baldhill Dam
380007	Sheyenne River	at Lisbon
385001	Sheyenne River	near Kindred
384155	Maple River	at Mapleton
380156	Goose River	at Hillsboro
384156	Red River	at Grand Forks
380037	Turtle River	at Manvel
380039	Forest River	at Minto
380157	Park River	at Grafton
380158	Pembina River	at Neche
384157	Red River	at Pembina
384130	James River	at Grace City
380013	James River	at Jamestown
380012	James River	at LaMoure
380022	Little Missouri River	at Medora
380059	Little Missouri River	S of Watford City on Hwy 85 bridge
384131	Knife River	near Golden Valley
380060	Spring Creek	at Zap
380087	Knife River	at Hazen
380160	Heart River	above Lake Tschida
380151	Heart River	near Mandan
380077	Cedar Creek	at Raleigh
380105	Cannonball River	near Raleigh
380067	Cannonball River	S of Breien

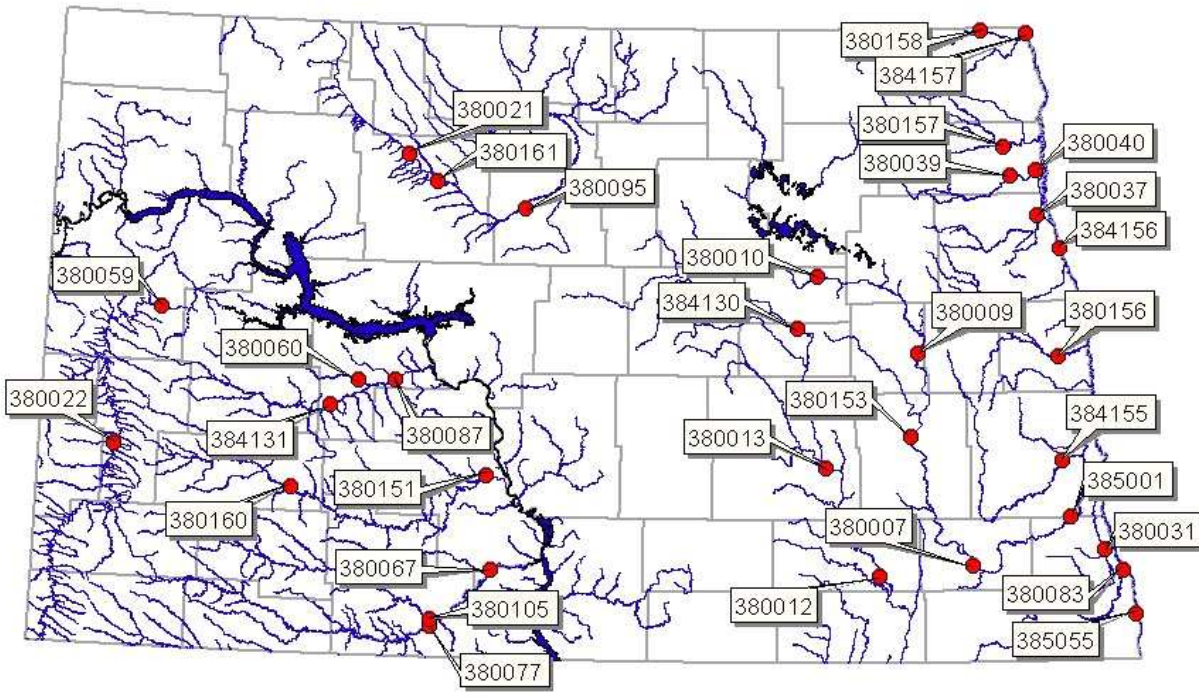

Figure IV-1. Ambient Water Quality Monitoring Network for Rivers and Streams

B. Biological Monitoring Program

1. Current and Historic Programs

The department first conducted state wide biological monitoring of its rivers and streams from 1993 through 2000 using a **rotating basin approach with intensive targeted sampling sites**. In response to a recognized need for more and better water quality assessment information, the department initiated a biological monitoring program in 1993. This initial program, a cooperative effort with the Minnesota Pollution Control Agency and the USGS's Red River National Water Quality Assessment Program, was conducted in 1993 and 1994 and involved approximately 100 sites in the Red River Basin. The result of this initial program was development of the index of biological integrity (IBI) for fish in the Red River Basin. This program continued in the Red River Basin in 1995 and 1996 with the sampling of an additional 100-plus biological monitoring sites – in the Souris River Basin in 1997, in the James River Basin in 1998, and in the Missouri River Basin in 1999 and 2000. The Upper Red River Basin, including the Sheyenne River and its tributaries, was sampled in 1995, while the Lower Red River Basin was sampled in 1996. Beginning in 1995, biological monitoring was expanded to include macroinvertebrate sampling in addition to fish. A habitat assessment also was conducted at each site following the Rapid Bioassessment

Table IV-2. Ambient Water Quality Monitoring Parameters

Field Measurements	Laboratory Analysis			
	General Chemistry	**Trace Elements**	**Nutrients**	**Biological**
Temperature	Sodium	Aluminum	Ammonia	Fecal coliform
pH	Magnesium	Antimony	Nitrate-nitrite	E. coli
Dissolved Oxygen	Potassium	Arsenic	Total Kjeldahl Nitrogen	Enterococcus sp.
Specific Conductance	Calcium	Barium	Total Nitrogen	
	Manganese	Beryllium	Total Phosphorus	
	Iron	Boron		
	Chloride	Cadmium		
	Sulfate	Chromium		
	Carbonate	Copper		
	Bicarbonate	Lead		
	Hydroxide	Nickel		
	Alkalinity	Silver		
	Hardness	Selenium		
	Total Dissolved Solids	Thallium		
	Total Suspended Solids	Zinc		

Protocols published by EPA. The purpose of this biological monitoring program was to (1) develop an IBI for fish and macroinvertebrates and (2) provide an assessment of aquatic life use attainment for those stream reaches that were assessed.

The rotating basin monitoring program was discontinued in 2001 while the department focused its resources in support of sampling for EPA's **Environmental Monitoring and Assessment Program (EMAP) Western Pilot Project**. The EMAP Western Pilot Project is the second regional pilot project within EMAP focusing on multiple resources. The first of these regional pilot projects focused on the mid-Atlantic region (Maryland, Delaware, Pennsylvania, Virginia and West Virginia). The Western Pilot is a five-year effort (2000-2004) targeted for the western conterminous United States. The pilot involves three EPA Regions (VIII, IX and X) and 12 states (North Dakota, South Dakota, Montana, Wyoming, Colorado, Utah, Arizona, Nevada, Idaho, California, Washington and Oregon). The pilot has three main resource components: surface waters (rivers and streams), landscapes and near coastal (estuaries and coastal waters).

North Dakota is part of the Western Pilot's Surface Water Project. The stated purpose of this part of the pilot is to: (1) develop the monitoring tools (e.g., biological indicators, stream survey design methods and description[s] of reference condition) necessary to produce unbiased estimates of the ecological condition of rivers and streams that are applicable for the west; and (2) demonstrate those tools in assessments of ecological condition of rivers and streams across multiple geographic regions in the west. In addition to state- and regional-specific assessment questions, the goal of the EMAP Western Pilot's Surface Water Project is to provide answers to three general assessment questions: (1) What proportion of the perennial river and stream miles in the western United States are in acceptable (or poor) biological condition? (2) What is the relative importance of potential stressors (e.g., habitat modification, sedimentation, nutrients, temperature, toxic contaminants, grazing, urbanization) in rivers and streams across the west? and (3) With what stressors are perennial rivers and streams in poor condition associated? In addition to answering these questions for the western 12-state region of the United States, the EMAP sampling design will allow these questions to be answered in each of the three EPA regions in the west, in each participating state and in several more spatially-intensive "focus areas" in each region. Within North Dakota, these areas are the Upper Missouri River Basin and the Northern Glaciated Plains Ecoregion.

Field sampling for the project began in 2000 and will continue through 2004. Based on the EMAP study design, approximately 50 to 60 sites will be sampled within each state and focus area during the five-year monitoring period. Sites are chosen by EMAP staff based on a random site-selection process. By randomly selecting sites, results can be extrapolated to the entire resource population of concern (in this case, all perennial rivers and streams in the west, EPA Region VIII, North Dakota, the Missouri River Basin and the Northern Glaciated Plains Ecoregion). Ninety-eight sites were sampled in North Dakota through 2003. Sixty-three of these sites were randomly selected sites, and 35 were chosen as "targeted reference" sites. Reference sites exemplify river and stream reaches that are considered "least impaired" with respect to anthropogenic (human) disturbance or stress. An additional 12 reference sites are scheduled for sampling in 2004.

Another key objective of the Western EMAP Pilot is to build state and tribal capacity for long-term monitoring through the development of monitoring tools, sampling designs and analytical capability, and by creating strong partnerships between states, tribes, EPA Region VIII, EPA's Office of Research and Development and other federal resource agencies. In order to meet this objective, EPA has encouraged the states to take the lead in carrying out the monitoring component of the project. In North Dakota, the North Dakota Department of Health's Division of Water Quality is a partner in the project and has entered into a cooperative agreement with the North Dakota district of the U.S. Geological Survey to conduct sampling. It is anticipated that results from this project will become available beginning in 2005.

2. Future Program Plans

Working cooperatively with the Minnesota Pollution Control Agency and possibly with Manitoba Water Stewardship and Environment Canada, the department intends to begin biological monitoring for fish and macroinvertebrates in the Red River Basin in 2005. Following biological monitoring in the Red River basin in 2005 and/or 2006 the department plans to resample the Souris River, James River and Missouri River basins using a rotating basin approach. Sampling procedures for fish, macroinvertebrates and physical habitat will follow those employed by the EMAP Western Pilot, and sample sites will be selected in each basin based on a probabilistic design. Targeted reference sites (i.e., best available) and impaired sites in each basin also will be selected based on an "a priori" screening process and sampled. The results from these sites will be used to refine existing multi-metric IBIs for both fish and macroinvertebrates.

C. Lake Water Quality Assessment Program

1. Current and Historic Program

The department currently recognizes 224 lakes and reservoirs for water quality assessment purposes. Of this total, 134 are manmade reservoirs and 90 are natural lakes. All lakes and reservoirs included in this assessment are considered significantly publicly owned.

Reservoirs are defined as waterbodies formed as a result of dams or dugouts constructed on natural or manmade drainages. Natural lakes are waterbodies having natural lake basins. A natural lake can be enhanced with outlet control structures, diversions or dredging. Based on the state's Assessment Database (ADB), the 134 reservoirs have an areal surface of 542,868 acres. Reservoirs comprise about 76 percent of North Dakota's total lake/reservoir surface acres. Of these, 480,731 acres or 67 percent of the state's entire lake and reservoir acres are contained within the two mainstem Missouri River reservoirs (Lake Sakakawea and Lake Oahe). The remaining 132 reservoirs share 62,137 acres, with an average surface area of 471 acres.

The 90 natural lakes in North Dakota cover 172,051 acres, with approximately 125,000 acres or 73 percent attributed to Devils Lake. The remaining 89 lakes average 523 acres, with half being smaller than 200 acres.

In 1991, through a grant from the EPA Clean Lakes Program, the department initiated the **Lake Water Quality Assessment (LWQA) Project**. Since that time, the department has completed sampling and analysis for 111 lakes and reservoirs in the state. The objective of the assessment project is to describe the general physical and chemical condition of the state's lakes and reservoirs, including trophic status.

The lakes and reservoirs targeted for assessment were chosen in conjunction with the North Dakota Game and Fish Department. Criteria used during the selection process were geographic distribution, local and regional significance, fishing and recreational potential and relative trophic condition. Lakes without much historical monitoring information were given the highest priority.

The results from the LWQA Project have been prepared in a functional atlas-type format. Each lake report discusses the general description of the waterbody, general water quality characteristics, plant and phytoplankton diversity, trophic status estimates and watershed condition.

One of the most useful measures of lake water quality is trophic condition. Trophic condition is a means of expressing a lake's productivity as compared to other lakes in a district or geographical area. In general, oligotrophic lakes are deep, clear lakes with low primary production, while eutrophic lakes are shallow and contain macrophytes and/or algae. Eutrophic lakes are considered moderately to highly productive.

The trophic condition or status is assessed for each of the lakes and reservoirs included in the LWQA. Accurate trophic status assessments are essential for making sound preservation or improvement recommendations. In order to minimize errors in classification, a multiple indicator approach was initiated.

Since trophic status indices specific to North Dakota waters have not been developed, Carlson's trophic status index (TSI) (Carlson, 1977) was chosen to delineate the trophic status of an LWQA Project lake or reservoir. To create a numerical TSI value, Carlson's TSI uses a mathematical relationship based on three indicators: secchi disk transparency in meters, surface total phosphorus in $\mu g\ L^{-1}$ and chlorophyll-a in $\mu g\ L^{-1}$.

This numerical value then corresponds to a trophic condition ranging from 0 to 100, with increasing values indicating a more eutrophic condition. Carlson's TSI estimates are calculated using the following equations:

- Trophic status based on secchi disk (TSIS):
  TSIS = 60 - 14.41 ln (SD)
  Where SD = Secchi disk transparency in meters.

- Trophic status based on total phosphorus (TSIP):
  TSIP = 14.20 ln (TP) + 4.15
  Where TP = Total phosphorus concentration in $\mu g\ L^{-1}$.

- Trophic status based on chlorophyll-a (TSIC):
  TSIC = 9.81 ln (TC) + 30.60
  Where TC = Chlorophyll-a concentrations in $\mu g\ L^{-1}$.

A major drawback to using Carlson's TSI is that it was developed for lakes that are primarily phosphorus limited. Because most North Dakota lakes and reservoirs have an abundance of phosphorus, ancillary information (e.g., dissolved oxygen concentrations, frequency of nuisance algal blooms, phytoplankton community structure and macrophyte biomass) was combined with Carlson's numerical TSI to prevent misclassification. Due to variations in geological and ecological regions and lake type (manmade or natural), numerical trophic status assessments were not assigned to waterbodies during the LWQA Project. Instead, the general trophic condition of the waterbody (e.g., mesotrophic, eutrophic or hypereutrophic) is identified.

In addition to the chemical monitoring and analysis, a land-use assessment is completed for each lake assessment. Each lake's watershed is assessed to identify the major sources of point- and nonpoint-source pollution. Land use and land-use practices were inventoried by interviewing local Natural Resources Conservation Service (NRCS) field office staff and state NRCS personnel. This inventory was verified in the field in the late fall. An aerial watershed survey also was performed on approximately one-third of all lakes assessed.

Point-source assessments were accomplished for each watershed with the assistance of the department's National Pollutant Discharge Elimination System (NPDES) Permit Program staff. All contributing point sources were identified, and an estimate was made of the probable nutrient and organic loading to each lake or reservoir and its impact.

Beginning in 1997, LWQA Project activities were integrated into the department's **rotating basin monitoring strategy**. Lake Darling and the Upper Des Lacs Reservoir were sampled as the department focused its monitoring activities in the Souris River Basin in 1997. Pipestem Dam and Jamestown Reservoir were sampled in 1998; Lake Sakakawea was sampled in 1999; and Bowman-Haley Reservoir, Patterson Lake and Lake Tschida were sampled in 2000.

In addition to their inclusion in the annual LWQA Project, Devils Lake and Lake Sakakawea have received special attention. Devils Lake has increased in elevation 26 feet since 1993. In response to questions regarding water quality changes resulting from these water level increases, the department initiated a comprehensive water quality monitoring program in 1993 for Devils Lake. Devils Lake is sampled approximately five times per year, including once during the winter.

While Devils Lake has increased in elevation over the last 10 years, Lake Sakakawea's lake level has dropped significantly since 2002. This drop has been due to drought conditions in the upper Missouri River Basin of Montana resulting in reduced runoff and by the U.S. Army Corps of Engineers' operating policies, which favor downstream navigation interests over the health and condition of the

upper Missouri River reservoirs. Of particular concern in North Dakota is the quality of Lake Sakakawea's cold water fishery. Since 2002, the department and the North Dakota Game and Fish Department have cooperated in a project to monitor the condition of the lake. Sampling consists of weekly dissolved oxygen (DO)/temperature profiles and water quality samples collected once each month at seven locations.

While not a significant component of the state's lake assessment program, the department also cooperates and assists lake associations and citizen groups with volunteer lake monitoring and assessment projects. When a group or association requests assistance department staff will meet with the group to define the overall goals and objectives of the project. Based on these goals and objectives, the department will prepare a sampling plan and provide training in sampling methods. The group is responsible for day-to-day monitoring activities, and the department provides laboratory analysis of all samples collected.

2. Future Program Plans

Given their statewide significance, Devils Lake and Lake Sakakawea will continue to be monitored by the department. Even with the cooperation and assistance provided by the North Dakota Game and Fish Department, sampling Lake Sakakawea requires a significant manpower commitment. The department will be looking for other partners (e.g., U.S Army Corps of Engineers and USGS) to help with this effort.

Many of the lake/reservoir assessments conducted as part of the LWQA Project are now nine to 15 years old. Since this time, there has been a severe drought and significant statewide flooding, both which may have affected water quality. These climatic factors, along with normal eutrophication, make the assessments conducted as part of the LWQA Project highly questionable.

Given the availability of adequate resources, the department plans to develop and re-initiate a **targeted state wide LWQA Program**. Through this program, 20 to 25 lakes would be targeted for sampling each year over a 10-year period. Samples would be collected twice during the summer (May/June and July/August) and once during the winter. The purpose of this program will be to collect data from all of the state's significantly publicly owned lakes in a 10-year period. The data are necessary to: (1) characterize general water quality conditions; (2) assess trophic conditions; (3) determine trends; and (4) assess whether beneficial uses are being met.

The department will also continue to encourage and support ongoing volunteer lake monitoring and assessment programs and seek new partnerships with lake associations and citizen volunteer groups.

D. Fish Tissue Contaminant Surveillance Program

1. Current and Historic Program

The purpose of the Fish Tissue Surveillance Program is to protect human health by monitoring and assessing the levels of commonly found toxic compounds in fish from the state's lakes, reservoirs and rivers. The department has maintained an active fish tissue monitoring and contaminant surveillance program since 1990. As part of this program, individual fish tissue samples are collected from selected lakes, reservoirs and rivers throughout the state and analyzed for methyl-mercury. For example, in 2004, the department cooperated with the North Dakota Game and Fish Department Fisheries Division in the collection and analysis of 700 fish tissue plug samples from 24 lakes and reservoirs, including Devils Lake and Lake Sakakawea.

These data are then used to issue annual species-specific fish advisories for the state's rivers, lakes and reservoirs based on risk-based consumption levels. The approach compares the estimated average daily exposure dose for specific waterbodies and species to EPA's recommended reference dose (RfD) for methyl-mercury. Using these relationships, fish tissue data are interpreted by determining the consumption rate (e.g., two meals per week, one meal per week or one meal per month) that would likely pose a health threat to the general population and to sensitive populations (i.e., children or pregnant or breast-feeding women).

The department has also participated in sampling for the National Fish Tissue in Lakes Survey. Eight lakes were selected in North Dakota as part of the national probability survey of 500 lakes and reservoirs. Sampling took place from 2000 through 2003.

2. Enhanced Program

Currently, fish tissue sampling is limited to lakes and reservoirs throughout the state that are sampled by the North Dakota Game and Fish Department Fisheries Division as part of its routine fisheries management activities (e.g., population surveys). And with the exception of a few special investigations, samples are only analyzed for methyl-mercury. The objectives of an enhanced fish tissue surveillance program would be to achieve statewide coverage of fish tissue sampling, including rivers and stream, and would include analysis of additional contaminants such as heavy metals, pesticides and other organic compounds (e.g., PCBs and dioxin).

E. Wetland Monitoring and Assessment Program

1. Current and Historic Program

Wetlands are often ignored in state water quality monitoring and assessment programs. However, with more than 2.5 million acres of wetlands in the state, the department believes wetland monitoring and assessment should be an important component of its overall water quality monitoring and assessment strategy. To meet its monitoring and assessment goals and objectives for wetlands, the department began developing a Wetland Monitoring and Assessment Program in the early 1990s.

Key to the Wetland Monitoring and Assessment Program has been the development of an IBI for macroinvertebrates and plants to be used as a tool for assessing the ecological condition of wetlands. While the development of widely applicable and robust indicators for macroinvertebrates has met with limited success, the development of an IBI for wetland plants has been extremely successful. Working in collaboration with the department and with funding provided by EPA's Wetland Program Grants, researchers in the North Dakota State University (NDSU) Animal and Range Sciences Department have developed IBIs for plants for temporary, seasonal and semi-permanent depressional wetlands. These IBIs can be applied throughout the Northern Glaciated Plains and Northwestern Glaciated Plains ecoregions.

While an IBI approach to wetland assessment can provide very precise information on the biological condition of individual wetlands or populations of wetlands within regions (e.g., watersheds or ecoregions), it does require the use of personnel skilled in wetland plant identification and can be costly to implement, especially on large regional scales. In order to find a wetland assessment method that is less costly to implement, the department is also collaborating with NDSU's Animal and Range Sciences Department to develop a regional-scale wetland assessment methodology using satellite remotely sensed data and GIS tools. This approach is being developed by assembling calibration and verification plant IBI data from wetlands sampled previously and by using multi-spectral Landsat TM and ETM+ satellite data.

2. Future Program Plans

With the development of plant IBIs nearly complete for temporary, seasonal and semi-permanent depressional wetlands in the Northern Glaciated Plains and Northwestern Glaciated Plains ecoregions, the department plans to begin development of a regional-scale wetland assessment pilot project. The purpose of this project will be to: (1) assess the biological condition of wetlands on a large geographic scale using a probabilistic study design to select and sample wetlands; and (2) apply the plant IBI to assess wetland condition. Results of this regional assessment will then be compared to wetland assessment results that will be

conducted using the remote sensing methodology.

Other program plans for the future will be to develop wetland assessment methodologies for other wetland classes (e.g., riverine, lacustrine and slope) and to further investigate the use of other biological assemblages (e.g., macroinvertebrates, algae, amphibians or birds) in the development of wetland assessment indicators. The department would also like to refine existing, more labor-intensive wetland assessment methods into a "rapid assessment method" (RAM) for use by volunteer monitoring groups and the regulated community.

F. TMDL Development Program

1. Program Background

Section 303(d) of the CWA and its accompanying regulations (CFR Part 130 Section 7) require each state to list waterbodies (i.e., lakes, reservoirs, rivers, streams and wetlands) that are considered water quality limited and require load allocations, waste load allocations and TMDLs. This list has become known as the "TMDL list" or "Section 303(d) list."

A waterbody is considered water quality limited when it is known that its water quality does not or is not expected to meet applicable standards. Waterbodies can be water quality limited due to point source pollution, NPS pollution or both.

When a state prepares its list of water quality-limited waterbodies, it is also required to prioritize waterbodies for TMDL development and to identify those waterbodies that will be targeted for TMDL development within the next two years. Factors to be considered when prioritizing waterbodies for TMDL development include: (1) the severity of pollution and the uses which are impaired; (2) the degree of public interest or support for the TMDL, including the likelihood of implementation of the TMDL; (3) recreational, aesthetic and economic importance of the waterbody; (4) the vulnerability or fragility of a particular waterbody as an aquatic habitat, including the presence of threatened or endangered species; (5) immediate programmatic needs, such as wasteload allocations needed for permit decisions or load allocations for Section 319 NPS project implementation plans; and (6) national policies and priorities identified by EPA.

After considering each of the six factors, the state has developed a three-tiered priority ranking. Waterbodies listed as Priority 1 have been further categorized. Priority 1A are lakes and reservoirs and river and stream segments for which TMDLs are scheduled to be completed and submitted to EPA in the next two years. Priority 1B are lakes and reservoirs and river and stream segments for which TMDL development projects are scheduled to be started in the next two years. The majority of these Priority 1A and 1B waterbodies were identified as such based largely on their degree of public support and interest and the

likelihood of implementation of the TMDL once completed. Priority 2 waterbodies are those river and stream segments and lakes and reservoirs that are scheduled for completion in the next 10 years.

Waterbodies for which fish consumption use is impaired due to methyl-mercury are considered Priority 3. These waterbodies are a low priority for TMDL development in the state. TMDL development for methyl-mercury-contaminated waterbodies is complicated by several factors, including: (1) uncertainty regarding the fate and transport of atmospheric sources of mercury; and (2) the complexity of the biological and geochemical interactions that affect the conversion of elemental mercury to methyl-mercury and its bioaccumulation rate in fish. Due to these complexities and the interstate and international nature of atmospheric mercury sources, it is the department's recommendation that EPA take the lead in developing mercury TMDLs.

The state's list of impaired waters needing TMDLs along with their priority ranking is submitted to EPA on April 1st of every even-numbered year in the form of the *Integrated Water Quality Assessment Report*.

2. TMDL Development Projects

The responsibility for TMDL development in North Dakota lies primarily with the department's Surface Water Quality Management Program. TMDL development staff are located in three regional field offices in Dickinson, Fargo and Towner, North Dakota. Technical support for TMDL development projects and overall program coordination are provided by Surface Water Quality Management Program staff located in Bismarck, North Dakota.

Historically, the technical and financial resources necessary to complete the state's TMDL development priorities have hampered the pace of TMDL development in the state. Recently, however, the state's TMDL program has seen an improvement in the financial resources available for TMDL development projects. While still significantly short of the funding necessary to meet the state's TMDL development schedule, EPA and the state of North Dakota have made available additional grants and funding to complete TMDLs. Examples of these new financial resources include the TMDL development grant available through EPA Regional VIII and state funding through the North Dakota Game and Fish Department's Save Our Lakes Program.

Typically, TMDL development projects involve monitoring and assessment activities which will:

- Quantify the amount of a pollutant that the impaired water can assimilate and still meet water quality standards.
- Identify all sources of the pollutant contributing to the water quality impairment or threat.

- Calculate the pollutant loading entering the waterbody from each source.
- Calculate the reduction needed in the pollutant load from each source necessary for attainment of water quality standards.

The goals, objectives, tasks and procedures associated with each TMDL development project are described in project-specific Quality Assurance Project Plans.

G. Nonpoint Source Pollution Management Program Monitoring

1. Program Backgound

In 1987, Congress acted on the need to expand the nation's pollution control efforts when it included provisions to control nonpoint source pollution in Section 319 of the reauthorized Clean Water Act. Nonpoint source (NPS) pollution, as defined in the Act, is pollution caused by diffuse sources that are not regulated as point sources. In more basic terms, NPS pollution can be a variety of contaminants (e.g., sediments, nutrients, etc.) that are delivered to surface waters by way of runoff or leached downward into groundwater. Some common sources of NPS pollution include urban streets and parking lots, construction sites and agricultural lands.

Given the size of the agricultural industry in North Dakota, agriculture and its associated activities have been the primary focus of the state's NPS Pollution Management Program. Since 1990, a majority of the state's Section 319 funds have been directed toward locally sponsored projects promoting voluntary NPS pollution control on agricultural lands. These funds have generally been used to implement various information/education activities and/or provide the necessary financial and technical assistance to landowners implementing best management practices (BMPs) on their lands. In recent years, Section 319 funding has also been used to support local initiatives to evaluate water quality conditions and determine sources and causes of NPS pollution within priority watersheds.

Since the reauthorization of the Clean Water Act in 1987, the North Dakota NPS Pollution Management Program has used Section 319 funding to support over 90 local projects throughout the state. While the size, target audience and design of the projects have varied significantly, they all share the same basic objectives. These common objectives are: (1) increase public awareness of NPS pollution issues; (2) reduce/prevent the delivery of NPS pollutants to waters of the state; and (3) disseminate information on effective solutions to NPS pollution where it is threatening or impairing uses.

State and local projects currently supported with Section 319 funding essentially include three different types of projects. These project types or categories are: (1) development phase projects; (2) educational projects; and (3) watershed projects.

Although most projects clearly fit into one of these categories, there are also several projects which include components from all three categories. A portion of the Section 319 funds awarded to the state have also been used to assess major aquifers in the state as well as promote and implement practices that prevent groundwater contamination.

2. NPS Development Phase Project Monitoring

Locally sponsored NPS assessment or TMDL development projects continue to be the primary means to determine watershed priorities and to prescribe specific management measures. These local assessments, commonly referred to as "development projects," provide the foundation for watershed implementation projects. The primary purposes of development phase projects are to identify beneficial use impairments or threats to specific waterbodies and to determine the extent to which those threats or impairments are due to NPS pollution.

Work activities during a development phase project generally involve an inventory of existing data and information and supplemental monitoring, as needed, to allow an accurate assessment of the watershed. Through these efforts, the local project sponsors are able to: (1) determine the extent to which beneficial uses are being impaired; (2) identify specific sources and causes of the impairments; (3) establish preliminary pollutant reduction goals or TMDL endpoints; and (4) identify practices or management measures needed to reduce the pollutant sources and restore or maintain the beneficial uses of the waterbody. Development phase projects are generally one to two years in length.

As is the case with TMDL development projects, responsibility for development and implementation of NPS assessment projects lies primarily with the department's Surface Water Quality Management Program. Regional TMDL development staff are also responsible for coordinating NPS assessment projects. Technical support for assessment projects and overall program coordination are provided by Surface Water Quality Management Program staff located in Bismarck.

The goals, objectives, tasks and sampling procedures associated with each NPS assessment project are described in project-specific Quality Assurance Project Plans (QAPPs).

3. NPS Watershed Implementation Project Monitoring

Watershed projects are the most comprehensive projects currently implemented through the NPS Pollution Management Program. These projects are typically the long-term in nature (five to ten years, depending on the size of the watershed and extent of NPS pollution impacts) and are designed to address documented NPS pollution impacts and beneficial use impairments within approved priority watersheds. Common objectives for a watershed project are to: (1) protect and/or

restore impaired beneficial uses through the promotion and voluntary implementation of best management practices (BMPs) that reduce/prevent documented NPS pollution loadings; (2) disseminate information on local NPS pollution concerns and effective solutions to those concerns; and (3) evaluate the effectiveness of implemented BMPs in meeting the NPS pollutant reduction goals of the project.

In order to evaluate the water quality improvement effects of BMPs that are implemented as part of a Section 319 NPS watershed restoration project, Surface Water Quality Management Program staff assist local sponsors with the development and implementation of QAPPs specific to the pollutant reduction goals or TMDL endpoints described in the watershed restoration project implementation plan. Each QAPP developed for a watershed restoration project provides a detailed description of the monitoring goals, objectives, tasks and sampling procedures.

H. Support Projects and Special Studies

Support projects and special studies are activities that are conducted on an as-needed basis to provide data or information to either answer a specific question or to provide program support.

Special studies provide immediate and in-depth investigations of specific water quality problems or emerging issues and usually involve practical research. In conducting practical research, the Surface Water Quality Management Program may rely on its own staff or may contract with the USGS, academia or private consultants. Examples of special studies projects conducted by the department include:

- Studies to develop nutrient criteria for streams and lakes.
- Time of travel studies, dispersion and reareation studies in support of water quality model development.
- The Lostwood National Wildlife Refuge wetland mercury assessment project.

Support projects are activities conducted or supported by the department that result in products or tools that enhance overall program efficiency or lead to new assessment methods. Examples of support projects conducted or supported by the department include:

- Studies to evaluate or compare monitoring methods.
- The watershed and sub-watershed delineation and digitization project.

I. Complaint and Fish Kill Investigations

1. Complaint Investigations

The primary purpose for the investigation of complaints is to determine: (1) whether or not an environmental or public health threat exists; and (2) the need for corrective action where problems are found. Since customer service is a primary focus of the department, complaint response is a very high priority. When complaints are received by the department, they may be handled by department staff, including staff in other divisions of the Environmental Health Section, or forwarded to one of the local health districts located across the state. Once the complaint is routed to the appropriate state or local health district staff person, a field investigation is usually conducted. When problems are identified, voluntary correction is obtained in most cases, but necessary enforcement action can be take under the state water pollution laws (NDCC 61-28) and regulations or under other applicable state or federal laws.

2. Fish Kill Investigations

Fish mortalities can results from a variety of causes and sources, some natural in origin and some induced by man. It is recognized that speed is all-important in the initial phases of a fish kill investigation. Therefore, persons reporting a fish kill are encouraged to contact the Health Department or the North Dakota Game and Fish Department during normal working hours or Emergency Response through state radio. Once a fish kill is reported, staff from the department's Surface Water Quality Management Program and/or North Dakota Game and Fish Department are dispatched to investigate. The extent of the investigation of a fish kill is dependent on the extent of the kill, the numbers and kinds of fish involved and the resources available at the time for the investigation. Following a decision to investigate, the investigation should continue until a cause is determined or until all known potential causes have been ruled out.

J. Stream Flow

1. Current and Historic Program

Stream flow data is critical to the analysis and interpretation of water quality data. Stream flow data is used to calculate critical flow conditions for TMDLs and NDPES permitting, to estimate pollutant loading and to interpret water quality results (e.g., load duration curve analysis). The USGS and agencies of the State of North Dakota have had cooperative agreements for the collection of streamflow records since 1903. During the 2003 water year (October 1, 2002 through September 30, 2003), the USGS cooperated with numerous state, federal and local agencies in the collection and reporting of stream flow data from 108 streamflow-gauging stations.

In addition to the extensive USGS streamflow gauging network, the department conducts flow monitoring at most water quality sites associated with NPS assessment and watershed implementation projects and TMDL development projects. This ensures that flow data is available for load calculations and other data analysis.

2. Future Program Plans

Diminishing resources, both state and federal, have significantly reduced the number of long-term streamflow gauging stations. Efforts should be made to maintain the current network of stations and to add or re-establish historic stations that have been discontinued.

V. CORE INDICATORS

The department's water quality monitoring program uses a suite of indicators to assess beneficial use attainment and to determine causes and sources of stressors affecting water quality. The department use a tiered approach that combines core indicators selected for each beneficial use and water resource type combination, plus supplemental indicators selected according to site-specific or project-specific decision criteria. Core and supplemental indicators for each water resource type (i.e., lakes, reservoirs, rivers, streams and wetlands) include physical, chemical, habitat, biological and landscape variables and metrics. Tables V-1, V-2 and V-3 provide a matrix of core and supplemental indicators used by the department to assess beneficial use attainment for rivers and streams, lakes and reservoirs and wetlands, respectively.

Table V-1. Core and Supplemental Indicators for Rivers and Streams

Indicator	Beneficial Uses Designation			
	Aquatic Life	**Recreation**	**Drinking Water**	**Fish Consumption**
Chemical				
Dissolved Oxygen	C			
Ammonia	C			
pH	C			
Sulfate			C	
Chloride			C	
Trace Metals				
Water column	C		C	
Mercury in fish tissue				C
Pesticides	S		S	
Nutrients	S	S		
Physical				
Temperature	C			
Habitat	S			
Flow	S			
Suspended Sediment	S			
Taste and Odor			S	
Biological				
Pathogens				
Fecal coliform		C		
E. coli		S		
Enterococcus		S		
Macroinvertebrates	C			
Fish	C			
Algae				
Periphyton	S			
Phytoplankton	S			
Chlorophyll	S		S	
Landscape (e.g., percentage cover of land uses, road density, population density)	S	S	S	

Table V-2. Core and Supplemental Indicators for Lakes and Reservoirs

Indicator	Beneficial Uses Designation			
	Aquatic Life	**Recreation**	**Drinking Water**	**Fish Consumption**
Chemical				
Dissolved Oxygen	C			
Ammonia	C			
pH	C			
Sulfate			C	
Chloride			C	
Trace Metals				
Water column	C		C	
Mercury in fish tissue				C
Pesticides	S		S	
Nutrients	C	C	S	
Physical				
Temperature	C			
Sediment	S	S	S	
Taste and Odor			S	
Secchi disk transparency	C	C		
Biological				
Pathogens				
Fecal coliform		C		
E. coli		S		
Enterococcus		S		
Fish	S			
Algae				
Phytoplankton	S			
Chlorophyll	S		S	
Eutrophic Condition				
TSI - Chlorophyll, Phosphorus, Sechhi disk	C	C	S	
Landscape (e.g., percentage cover of land uses, road density, population density)	S	S	S	

Table V-3. Core and Supplemental Indicators for Wetlands

Indicator	Beneficial Uses Designation	
	Aquatic Life	Recreation
Chemical		
Trace Metals		
Water column	S	
Mercury in tissues	S	
Pesticides	S	
Nutrients	S	
Physical		
Temperature	S	
Sediment		
Biological		
Pathogens		
Fecal coliform		C
E. coli		S
Enterococcus		S
Macroinvertebrates	S	
Plants	C	
Algae		
Phytoplankton	S	
Chlorophyll	S	
Hydrogeomorphic	S	
Landscape (e.g., percentage cover of land uses, road density, population density)	S	S

VI. DATA MANAGEMENT

A. Current Program

Efficient data management is essential to an effective water quality monitoring and assessment program. Data management is necessary for assessment, reporting, tracking, sharing data and meeting data quality objectives. Electronic data management technology has greatly expanded the department's ability to manage, present and share water quality information. Data management is organized around four main databases. The following describes of each of these databases.

1. Sample Identification Database (SID)

Since 1993, the department has maintained its own database management system. The Sample Identification Database (SID) is a Microsoft ACCESS database management system. All water column chemistry, fish tissue chemistry, sediment chemistry and field water quality data either collected by the department's Surface Water Quality Management Program or for the program under contract or cooperative agreement are entered into SID. All samples results generated by the

department's Chemistry Division are electronically transmitted to the Surface Water Quality Management Program where they are incorporated into SID by the database management coordinator. Field data (e.g., temperature, pH, dissolved oxygen and conductivity measurements) and sample custody information (e.g., station description, date and time collected and depth) are recorded on standardized forms and entered into SID by program personnel.

2. STORET

All data entered into SID are transmitted electronically into EPA's STOrage and RETrieval database, termed STORET. STORET is a national database management system that was created by EPA as a repository for water quality, biological and physical data. STORET contains data collected beginning in 1999, along with older data that has been properly documented and migrated from the Legacy Data Center (LDC). Both systems contain raw biological, chemical and physical data on surface and ground water collected by federal, state and local agencies, Indian Tribes, volunteer groups, academics and others. All 50 states, territories and jurisdictions of the U.S. are represented in these systems.

Each sampling result in the LDC and in STORET is accompanied by information on where the sample was taken (i.e., latitude, longitude, state, county, Hydrologic Unit Code and a brief site identification), when the sample was gathered, the medium sampled (e.g., water, sediment and fish tissue) and the name of the organization that sponsored the monitoring. In addition, STORET contains information on why the data were gathered; sampling and analytical methods used; the laboratory used to analyze the samples; the quality control checks used when sampling, handling the samples, and analyzing the data; and the personnel responsible for the data. All water quality data collected by the department since 1993 are in STORET, while data collected prior to 1993 are in the LDC. Data are transmitted electronically from SID into STORET once each year, usually in February.

3. Ecological Data and Application System (EDAS)

The department uses a customized version of the Ecological Data and Application System (EDAS) database to store and manage all of its biological and habitat assessment data. EDAS is an ACCESS database management and analysis tool that not only stores biological (e.g., fish and macroinvertebrate) and habitat assessment data, but also allows the user to calculate biological metrics using a set of predetermined queries and to export the results to EXCEL. Biological data and habitat assessment data entered into EDAS are downloaded to STORET.

4. Assessment Database (ADB)

With an estimated 54,427 miles of rivers and streams and 714,919 acres of lakes, it is impractical to adequately assess each and every mile of stream or every acre

of lake. However, the department believes it is important to (1) accurately assess those waters for which beneficial use assessment information is available and (2) account for those stream miles and lake acres that are not assessed or for which there is insufficient data to conduct an assessment. As a result, the department has adopted the Assessment Database (ADB) to manage water quality assessment information for the state's rivers, streams, lakes and reservoirs.

Developed by EPA, the ADB is an Microsoft ACCESS "accounting"/database management system that provides a standard format for water quality assessment information. It includes a software program for adding and editing assessment data and transferring assessment data between the personal computer and EPA. Assessment data, as compared to raw monitoring data, describes the overall health or condition of the waterbody by describing beneficial use impairment and, for those waterbodies where beneficial uses are impaired or threatened, the causes and sources of pollution affecting the beneficial use.

North Dakota's ADB contains 1,688 discreet assessment units (AUs) representing 54,427 miles of rivers and streams and 224 lakes and reservoirs. Within the ADB, designated uses are defined for each assessment unit (AU) (i.e., river or stream reach, lake, reservoir or wetland) based on the state's water quality standards. Each use is then assessed using available chemical, physical and/or biological data.

The ADB provides an efficient accounting and data management system. It also allows for the graphical presentation of water quality assessment information by linking assessments contained in the ADB to the National Hydrography Dataset (NHD) file through geographic information systems (GIS). In order to facilitate the GIS datalink, the department has "reach-indexed" each AU in the ADB to the NHD file. The product of this process is a GIS coverage that can be used to graphically display water quality assessment data entered in the ADB.

Reports generated from the ADB are used as the basis for the state's biennial *Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Impaired Waters Needing TMDLs.*

B. Future Program Plans

The department's database management coordinator continues to develop and refine reports and queries with SID and EDAS that allow for easy access and retrieval of information for anyone who requests it. It is the department's goal to develop a web-based query tool to make our data even more available to the public.

VII. DATA ANALYSIS AND REPORTING

North Dakota generates numerous reports dealing with findings associated with the department's water quality monitoring programs and projects. Reports range from those required by the Clean Water Act to technical reports summarizing the results of specific monitoring activities.

A. Clean Water Act Reporting

As part of its CWA reporting responsibilities, the department recently completed the *2004 Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Waters Needing Total Maximum Daily Loads* (NDDoH 2004) that was submitted and approved by EPA Region VIII. As the title indicates, this report combines reporting requirements under Section 305(b) of the CWA and Section 303(d). The primary purpose of the Section 305(b) *State Water Quality Assessment Report* is to assess and report on the extent to which beneficial uses of the state's rivers, streams, lakes, reservoirs and wetlands are met. Section 305(b) of the Clean Water Act requires states to submit this assessment report every two years. The Section 305(b) report is a summary report that presents information on use impairment and the causes and sources of impaired or threatened uses for the state as a whole. While the Section 305(b) report is considered a summary report, Section 303(d) and its accompanying regulations (CFR Part 130, Section 7) require each state to list individual waterbodies (i.e., lakes, reservoirs, rivers, streams and wetlands) that are considered water quality limited and that require load allocations, waste load allocations and TMDLs. This list has become known as the "TMDL list" or "Section 303(d) list."

For purposes of 2004 Integrated Report and subsequent reports, EPA has encouraged states to follow its integrated reporting guidance (EPA, 2001). Key to integrated reporting is an assessment of all of the state's waters and placement of those waters into one of five categories. The categories represent varying levels of water quality standards attainment, ranging from Category 1, where all of a waterbody's designated uses are met, to Category 5, where a pollutant impairs a waterbody and a TMDL is required (Table VII-1). These category determinations are based on consideration of all existing and readily available data and information consistent with the state's assessment methodology. As part of the integrated Section 305(b) and Section 303(d) reporting to EPA, the state also provides a copy of the Assessment Database (ADB) with that year's assessment information.

B. General Reporting

In addition to reporting required under the CWA, the department also produces a variety of annual, semi-annual and final reports for specific monitoring programs and projects. Regardless of the program or project, the goal of the department is to produce a written summary of all monitoring activities as soon as the data become available. Examples of general reports prepared by the department include:

- Lake assessment reports.

- TMDL development reports.
- NPS assessment reports.
- NPS watershed implementation project summary reports.
- Fish consumption advisories.
- Index of Biological Integrity (IBI) development reports.

Table VII-1. Assessment Categories for the Integrated Report

Assessment Category	Assessment Category Description
Category 1	All of the waterbody's designated uses have been assessed and are met.
Category 2	Some of the waterbody's designated uses are met, but there is insufficient data to determine if remaining designated uses are met.
Category 3	Insufficient data to determine whether any of the waterbody's designated uses are met.
Category 4	The waterbody is impaired or threatened, but a TMDL is not needed. This category has been further sub-categorized as: • 4A - waterbodies that are impaired or threatened, but TMDLs needed to restore beneficial uses have been approved or established by EPA. • 4B - waterbodies that are impaired or threatened, but do not require TMDLs because the state can demonstrate that "other pollution control requirements (e.g., BMPs) required by local, state or federal authority" (see 40 CFR 130.7[b][1][iii]) are expected to address all waterbody-pollutant combinations and attain all water quality standards in a reasonable period of time. • 4C - waterbodies that are impaired or threatened, but the impairment is not due to a pollutant.
Category 5	The waterbody is impaired or threatened for at least one designated use and a TMDL is needed.

VIII. QUALITY ASSURANCE/QUALITY CONTROL

To ensure that all environmental and related data collected, compiled and/or generated for the department are complete, accurate and of the type, quantity and quality required for their intended use, it is the policy of the department that all environmental monitoring be in conformance with the *Quality Management Plan for the Environmental Health Section* (NDDoH/EHS Revision 5, 29 June 2000) and with procedures described in project specific Quality Assurance Project Plans (QAPPs). All QAPPs are prepared according to guidance provided in the EPA document entitled *EPA Requirements for Quality Assurance Project Plans* (EPA, March 2001).

Overall organization for the department's Environmental Health Section is detailed in the *Quality Management Plan for the Environmental Health Section* (NDDoH/EHS Revision 5, 29 June 2000). The Environmental Health Section (EHS) is one of six sections in the department. Within the EHS there are five divisions: Air Quality, Municipal Facilities, Waste Management, Water Quality and Chemistry. Dana Mount is the quality assurance coordinator for the EHS. The quality assurance coordinator is located in the EHS Chief's Office and reports directly to the Chief. The Chief's Office and the quality assurance coordinator are responsible for oversight of the EHS's quality system for quality assurance (QA) and quality control (QC) as delineated in the *Quality Management Plan for the Environmental Health Section* (NDDoH/EHS Revision 5, 29 June 2000), including approving project QAPPs. It is the policy of the EHS that the primary responsibility for QA resides among program staff and designated project managers in each division; therefore, each program is responsible for the preparation, implementation, and assessment of its own project specific QAPPs.

Michael J. Ell is program manager for the Division of Water Quality's Surface Water Quality Management Program. As program manager he has the following QA/QC responsibilities:

- Reviewing and editing QAPPs.
- Providing oversight for study design, site selection, and adherence to design objectives.
- Reviewing and approving the final project work plans and other materials to support the project (e.g., standard operating procedures).
- Selecting appropriate project subcontractors, as needed.
- Coordinating with contractors, reviewers and EPA to ensure technical quality and contract adherence.

The Surface Water Quality Management Program's program manager also assigns a designated project manager for each QAPP. These designated project managers are responsible for overall project coordination and supervision, including the reduction and analysis of project data and the preparation of the final report.

To ensure that the department's QA/QC policies are adhered to, the SWQMP has instituted the following QA/QC activities and procedures:

- QAPPs and/or study plans must be submitted to the department's QAC for review and approval prior to implementation.
- All data will be recorded on standardized reporting forms and should include a description of the sampling site(s), date and time of collection and collector identification.
- Equipment used in sample collection will be cleaned, repaired and calibrated according to the manufacture's specifications, and a log will be maintained of all service and calibration activities.
- Standard Operating Procedures (SOPs) will be developed and periodically reviewed for all field sampling procedures (these SOPs should describe in detail the field sampling and/or measurement procedures, meter calibration and maintenance procedures, sample chain-of-custody documentation, sample preservation, holding times and recommended sample container specifications, data recording form examples and data submission requirements).
- Staff within the Surface Water Quality Management Program will provide training, at least once each year, to field investigators in the measurement and collection of water quality samples.
- All samples collected for analysis will be submitted for analysis to the appropriate laboratory following standardized chain-of-custody procedures.
- All data entered into the department's data management system will be reviewed, checked and edited prior to final submission to STORET.

IX. PROGRAM EVALUATION

The state, in conjunction with EPA, should conduct periodic monitoring program reviews and evaluations. In May 2003, EPA conducted a review of North Dakota's Monitoring and Assessment Program. This program review was conducted by Jill Minter, Monitoring Coordinator, and Vern Berry, TMDL Project Officer, and was based on the 10 key elements of a monitoring program described in the *Elements of a State Monitoring and Assessment Program* guidance document (EPA, March 2003). Recommendations provided in this review have been summarized and, to the extent possible, included in this monitoring strategy. The department will continue to refine its monitoring program through annual internal and external reviews.

A. Internal Program Review

By virtue of its organization, it is less difficult for the department to carry out internal program evaluations. The Surface Water Quality Management Program includes water quality standards, monitoring and assessment, the NPS Pollution Management Program, the TMDL Program and database management. Thus, programs are integrated and program evaluation is built into the organization. While there is not a formal internal evaluation process, the program's organization allows for ongoing analysis of data gaps and review to ensure monitoring objectives are met.

B. External Program Review

With the exception of the recently completed program review by EPA, there has never been any external review or input to the state's monitoring and assessment program. As part of this strategy, the department proposes to establish a state monitoring council made up of agencies and organizations in the state with an interest in water quality monitoring. The primary purpose of the council will be to review the state's monitoring strategy and to make recommendations for improving state monitoring and assessment programs. The council will also provide a forum and an opportunity for agencies and organizations to: (1) share monitoring ideas, data and results; (2) discuss monitoring program successes and failures; and (3) develop or expand partnerships among council member agencies and organizations.

X. GENERAL SUPPORT AND INFRASTRUCTURE PLANNING

It should be recognized that the department currently does not have the resources necessary to achieve all of the goals, objectives, programs and projects identified in this strategy. The Monitoring and Assessment Program is within the Division of Water Quality's Surface Water Quality Management Program and, as such, is responsible for implementing the Water Quality Standards, Monitoring and Assessment, TMDL, Nonpoint Source, Lake Water Quality, and Wetlands Programs.

For these multiple CWA programs, there are a total of 10.75 FTEs, including: 1 FTE (Manager), 1 FTE (Database Coordinator), 3.5 FTEs (Environmental Scientists/Water Quality Monitoring Specialists), 1 FTE (NPS Coordinator), 4 FTEs (TMDL/Watershed Liaisons), and 0.25 FTE (GIS Coordinator). Duties are not as clearly divided as noted above. For example, monitoring staff also analyze data and develop indicators, and TMDL staff collect samples at department fixed station network sites. The Surface Water Quality Management Program's main office is located in Bismarck, with three additional field offices located in Dickinson, Fargo, and Towner. Each field office is staffed by one full time equivalent (FTE).

One limitation to implementing an adequate monitoring and assessment program in North Dakota has been limited staff resources. Additional FTEs to support the Surface Water Quality Management Program would need to be authorized by the state legislature. The department has requested and received authority to hire one or two summer temporary employees each year, although requests are not always met in full.

In order to fill this resource gap, the department uses other partners to help meet its needs for water quality data and information. The department has been able to expand the amount of field work carried out to support its programs through cooperative agreements with the USGS North Dakota District Office, by contracting with local soil conservation districts and through the use of private consultants.

A bright spot in its water quality monitoring and assessment support and infrastructure are the expanded departmental services available to conduct laboratory analysis samples.

Both the department's Division of Chemistry and Division of Microbiology have just completed laboratory expansions and upgrades. The two laboratories provide virtually unlimited analyses of all water column, sediment and fish tissue samples collected by the department and its cooperating partners. The Chemistry laboratory provides analyses of major cations and anions, trace elements (including mercury), nutrients, total organic carbon, organic compounds (e.g., pesticides, VOCs, BTEX and PCBs), total suspended solids, biochemical oxygen demand and chlorophyll. The Microbiology laboratory provides analysis of samples for fecal coliform, E. coli and Enterococcus bacteria.

Funding to support current monitoring programs comes mainly from EPA via Section 106 block grants, Section 104(b)(3) consolidated funding grants for wetlands and TMDLs, Section 604(b) watershed management grants and Section 319 NPS grants. It is unlikely that increased state general funds will be made available to support expanded monitoring and assessment programs; therefore to meet the goals and objectives of this strategy EPA will have to significantly increase it's financial commitment to states for monitoring.

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